Margaret M. W.

SIGN-OFF SHEET

SPECIAL PROJECT

EVALUATION OF A PROPOSED

SPRUCE BUDWORM LOSS ASSESSMENT SURVEY IN MAINE

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SPECIAL PROJECT

WORK-PLAN

EVALUATION OF A PROPOSED SPRUCE BUDWORM LOSS ASSESSMENT SURVEY METHOD IN MAINE

Prepared by: Imants Millers, Entomologist
USDA Forest Service

INTRODUCTION

The spruce budworm has caused extensive tree mortality in the northeastern U.S. in recent history. Early outbreak in Maine during 1910-1920 was estimated to result in the loss of 27 MM cords. However, quantitative data are not available. In Minnesota, during the 1950s, spruce budworm killed about 1.5 MM cords of balsam fir or about 2.8 cords per acre of type. Tree mortality is becoming apparent in Maine as a result of the present outbreak.

ADMINISTRATIVE CONSIDERATIONS

Recently, emphasis is being made on data collection to show annual forest losses from major pests (memo from Thornton, 1-24-79, 3400). Annual loss assessment surveys are expected to begin in FY 1980. Present loss assessments involve local tree mortality estimates where the concentration of dead trees is of interest to the forest manager. A quantitative loss assessment method for these localized areas was developed by our office in 1978 (report in preparation). A similar method is proposed for use operationally in Maine. The efficiency of the method on large area, 1 MM acres or more, needs to be evaluated. In addition, an extensive mortality survey will help to establish a normal mortality base-line where trees have died from other than spruce budworm activity. For the annual survey method to be practical, it should be completed in about a month and not require more than 4 persons from the Maine Forest Service.

Standard prescribed survey techniques will be applied for spruce budworm loss assessment. Only tree mortality will be determined. This project was included in slightly different form in the 1979 Program of Work. Thus, no unusual impact on scheduled work is expected. Most of the field work-force will be available after the Maine's Spruce Budworm Operational Project (our project proposal of large aircraft vs small aircraft efficacy evaluation).

OBJECTIVES

The ultimate objective is to design a survey method for annual spruce budworm loss assessment to be used by our cooperators.

The accomplishment of specific objectives will provide the following information:

A. Extensive Survey

1. Estimate of average volume per acre and total volume in survey area of spruce and fir in terms of merchantable volume cords (±10%).
2. Estimate of merchantable volume that has died during the last year, derived as proportion of total volume.
3. Provide quantitative data for number of sample points needed for estimates of given accuracy.

B. Intensive Survey

1. Delineate concentrations of spruce-fir mortality in Maine's northwestern forest.
2. Estimate of commercial volume dead in the above areas.

C. Prescription of an Annual Survey Method

1. Compare estimates obtained from extensive and intensive survey.
2. Evaluate sample point selection schemes:
    a. Random selection of sample points.
    b. Regional stratification of sample point clusters.
    c. Sample points from easily accessible stands only.
3. Prepare an annual loss assessment survey plan.

METHODS

Extensive Survey

Systematically random sample points will be marked on the state spray map - at estimated ground spacing of about 2 miles apart. It will be done by locating dots on the map at 1 inch intervals on lines 1 inch apart. The survey area should have about 1000 sample points.

Spray - no spray separation:

Each sample point on the map will be evaluated for spray history on spray maps from last 5 years to determine if it has been sprayed. Sample points will be separated in 2 groups - sprayed and not sprayed.

Type determination:

Determination for presence of conifer, mixwood, or non-type will be made. Large scale satellite imagery will be used to withdraw sample points obviously without spruce-fir. This will be done both for sprayed and non-sprayed areas. In addition, in non-spray areas, examination will be made to identify points that have spruce-fir type and determination of why they were deleted from spraying - silvicultural withdrawals, spray buffers, or other.

Pre-field evaluation:

The maps showing selected sample points with spruce-fir type will be evaluated on larger scale photography, type maps or even by air observations. The main objective here will be to determine if the stand qualifies under tree requirements:

1. More than 30 percent fir-spruce.
2. Trees are at least 5" dbh.
3. Spruce component is white or red spruce, exclude black spruce.

Where possible, final confirmation will be made with landowners.

Sample points:

Each sample point will consist of 5 10-factor prism points located as follows. Sample point center is prism point 1; and the other four will be taken in cardinal compass directions, clockwise, and 2 chains away from the center.

The sample point location will be marked on the photo or map, showing the compass direction and the distance from nearest roadway (or waterway). The survey crew will be expected to find that location.

Prism points and data collection:

The center of the point will be marked with a staff. A 10-factor prism will be used to tally trees in the plot. A tree will be counted only when it has at least 1 pulpwood stick (8ft. and 4" min. top diameter). Borderline trees will be measured to decide on in or out.

Sample points will be identified by Township, Range and Section (MFS Fire Sections will be used). The over-all stand condition will be rated after all the prism points have been examined (MFS Ashley's code will be used). The tree data will be collected from 5 prism points at each sample point; however, all the data will be collected on one data sheet and used as 1 sample. Separate data sheets will be used for balsam fir and spruce.

At each prism point, a tally of merchantable trees will be taken by condition class.

1. Foliated live - green foliage present; all indications are that the tree will be alive next year.
2. Defoliated, and/or dying - lack of foliage or browning of needles in the crown; inner bark at dbh is white without signs of brown, or dead tissues.
3. Dead - recently dead tree with fine twigs still present; inner bark brown, or at least some browning present (check all 4 sides of tree at dbh).

Note on the tally sheet if tree appears to have died from other causes (but still, include in tally).

A separate estimate will be made for tree volumes, although the data will be recorded on the tally sheet. (Tree volume Tally Form from USFS R-9 will be used.) One live and 1 dead tree, if available will be measured at each sample point. It will be chosen at random, 1st tree from N in clockwise direction. If no dead trees are at a point, measure first dead tree on the way to the next point. The measurement will include dbh, 2-inch classes, beginning with 6 inch class, and the estimated number of merchantable pulpwood (8ft.) sticks (4 inch top dia.).

Data Analysis:

Total average volume per acre in cords will be determined for each group of sample points (sprayed, unsprayed buffers, etc.). The average spruce volume will be determined as proportion of the total average. Similarily, the average volume dead will be determined as proportion of total and as proportions within fir, and spruce. The error of estimate for average total volume per acre and errors for proportion volume estimates of spruce and dead trees will be determined.

From the above estimates we will estimate the number of sample points that should be taken in future surveys, assuming 10 percent and 25 percent error of the mean total volume per acre. In addition, number of sample points needed will be determined allowing not more than 0.5 cd error of estimate per acre for dead volume.

Program for analysis was developed by Mr. P. Treciokas in 1978 for analysis of similar survey on small areas. The same program, with necessary modifications, will be used for the analysis of 1979 data.

Intensive Survey

Area Selection:

Aerial flights over the survey area will be made to locate concentrations of trees with grey appearance. The assumption is that these areas are likely to have highest proportion of dead trees. Detection flights will be at 2000 ft. above ground (lower at poor visibility) flown about 6 miles apart. Mortality areas will be sketch-mapped on satellite imagery maps. These areas will be reflown at 500 ft. above ground and the boundaries of the mortality areas will be sketch-mapped. The mortality areas will be delineated on the largest scale type maps or aerial photographs. The over-all mortality area must be at least 10,000 acres. The spruce-fir type areas will be measured and sample points selected at random.

Sample points and data collection:

Sample points will consist of 5 10-factor prism points selected in the same manner as shown for extensive survey. Field data will be selected in similar fashion.

Data Analysis:

Data will be analyzed in similar manner as shown for extensive survey.

Reports:

Data analysis will begin December 1, 1979 (P. Treciokas will not be available to us between September 1 - December 1, because of expiration of his 180 day appointment. First draft of the report is targeted for February 1, 1980 and final report within 90 days.

PERSONNEL REQUIREMENTS

The project will be under general supervision of Dr. I. Millers, Portsmouth Field Office, USDA Forest Service. Mr. P. Treciokas will assist in the supervision of map preparation and field work. Data analysis will be done by P. Treciokas.

Field data will be collected by 5 crews, 2 persons per area, hired from temporary summer employment lists. One person per crew will be assigned as the crew boss. It is estimated that the field work will require about 6-8 weeks (300-400 person days).

BUDGET ESTIMATE

Item	Contributed PFO	Project Additional $
Salaries		
PFT		
TFT (180 days)		
TFT (summer)		16,000
Per Diem		
PFT	700	
TFT (180 days)	1,200	
TFT (summer)		20,000
Transportation		
Vehicle		5,000
Aircraft		2,500
Miscellaneous Supplies		1,000
Reports		1,000
Computer		1,000
TOTAL		$46,500

SPECIAL PROJECT

WORK-PLAN

EVALUATION OF A PROPOSED SPRUCE BUDWORM LOSS ASSESSMENT SURVEY METHOD IN MAINE

Prepared by: Imants Millers, Entomologist
USDA Forest Service

Introduction

The spruce budworm has caused extensive tree mortality in the northeastern U.S.. Early outbreak in Maine during 1910-1920 caused an estimated loss of 27 MM cords. However, quantitative data are not available. In Minnesota, during the 1950s, spruce budworm killed about 1.5 MM cords of balsam fir or about 2.8 cords per acre of type. Tree mortality is becoming more apparent in Maine as a result of the present outbreak.

Administrative Considerations

Recent guidelines from the Chief's Office emphasizes loss assessment from the major pests (Thornton, 1-24-79, 3400). In the Northeastern Area, the spruce budworm loss assessment is coordinated through the St. Paul Field Office (R. Ford). This proposal covers the basic Area-wide plans, but additional information will be obtained in Maine, where the problem is most severe.

Present loss assessment methods use standard forest survey estimation methods in areas where the forest manager has significant interest. State wide estimates are based on qualitative generalizations. A quantitative method, a rapid tree mortality assessment, was tested by this Field Office in 1978. A similar method is proposed here on a larger scale. In addition, it will be compared with large area systematic approach, using a standardized distribution of plots.

The proposed survey evaluation will be conducted in cooperation with Maine Forest Service and major industrial forest landowners and managers. The plan has been discussed with the cooperators. The cooperators will provide technical assistance, such as permission to use the forest lands for survey, provide maps, and advise on working-requirements on private lands. No financial contributions or work outside of normally planned activities by the cooperators are expected. The cooperators will be given opportunity to comment on the accomplishment report before final release.

Usual prescribed survey techniques will be applied for spruce budworm loss assessment. Only tree mortality will be determined. This project was included in slightly different form in the 1979 Program of Work. Thus, no unusual impact on scheduled work is expected. Most of the field work-force will be available after the Maine's Spruce Budworm Operational Project (our project proposal of large aircraft vs small aircraft efficacy evaluation).

Objectives

The ultimate objective is to evaluate several mortality assessment methods and to prescribe a method to be used in future surveys by our cooperators. This survey evaluation will provide the following specific information:

A. Extensive Survey

1. Estimate of average volume per acre and total volume in survey area of spruce and fir in terms of merchantable volume cords (25 percent Error of Mean).
2. Estimate of merchantable volume that has died during the last year, derived as proportion of total volume.
3. Provide quantitative data to determine the number of sample points needed for estimates of given accuracy.

B. Intensive Survey

1. Delineate areas with concentrations of spruce-fir mortality in Maine's northwestern forest.
2. Estimate the commercial volume dead in the above areas.

C. Prescription of an Annual Survey Method

1. Compare estimates obtained from extensive and intensive survey.

2. Evaluate sample point selection schemes:
    a. Random selection of sample points.
    b. Regional stratification of sample point clusters.
    c. Sample points from easily accessible stands only.
3. Prepare an annual loss assessment survey plan.

Methods for Extensive Survey

Sample point selection

Systematic and random methods will be used to select sample points. Nine sample points per standard township will be selected systematically (total about 1000). A process of elimination will be used to reduce that number (see attached decision chart).

1. Type determination:

Determination for presence of conifer, mixwood, or non-type will be made. Large scale satellite imagery will be used to withdraw sample points obviously without spruce-fir. This will be done both for sprayed and non-sprayed areas. In addition, in non-spray areas, examination will be made to identify points that have spruce-fir type and determination of why they were deleted from spraying - silvicultural withdrawals, spray buffers, or other.

2. Pre-field evaluation:

The maps showing selected sample points with spruce-fir type will be evaluated on larger scale photography, type maps or even by air observations. The main objective here will be to determine if the stand qualifies under tree requirements:

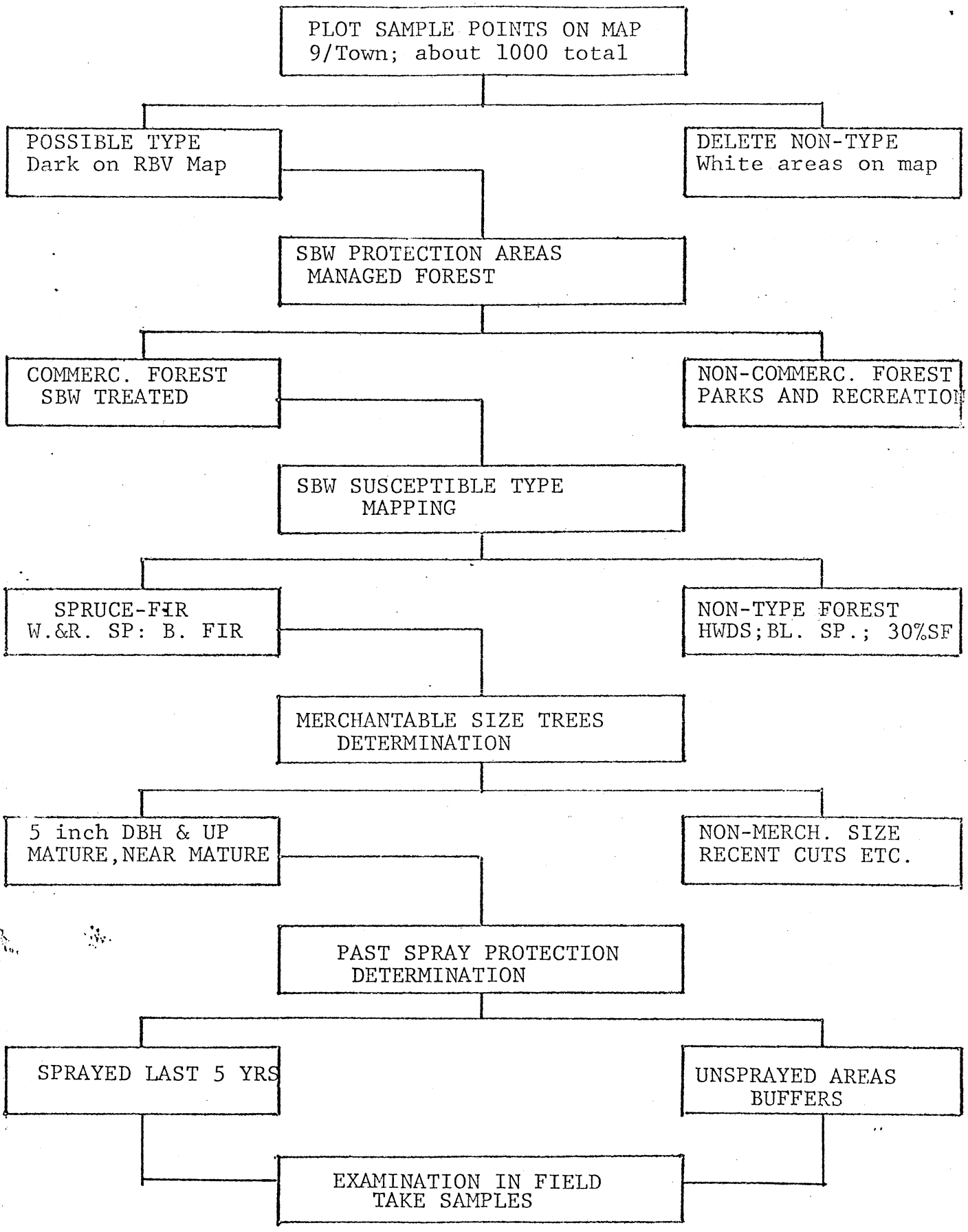
a. More than 30 percent fir-spruce.
b. Trees are at least 5" dbh.
c. Spruce component is white or red spruce, exclude black spruce.

Where possible, final confirmation will be made with landowners.

3. Random selection process:

In each township, or equivalent, only 4 or less sample points will be taken. Where the elimination process has more than 4 points remaining, random numbers will be drawn to sample only 4 points.

PLOT SELECTION DECISION MAKING CHART



One tree at each sample prism point will be measured for volume - number of eight foot long pulpwood sticks. Standard (R-9) volume tables will be used to convert the data to cubic foot volume. Top diameter of 4 inches outside bark will be accepted as minimum for merchantability. Each sample tree, live and dead, and spruce and fir will be chosen systematically - 1st tree from north, clockwise direction, within prism point.

Data analysis

Total average volume per acre in cords will be determined for each group of sample points (sprayed, unsprayed buffers, etc.). The average spruce volume will be determined as proportion of the total average. Similarily, the average volume dead will be determined as proportion of total and as proportions within fir, and spruce. The error of estimate for average total volume per acre and errors for proportion volume estimates of spruce and dead trees will be determined.

From the above estimates we will estimate the number of sample points that should be taken in future surveys, assuming 10 percent and 25 percent error of the mean total volume per acre. In addition, number of sample points needed will be determined allowing not more than 0.5 cd error of estimate per acre for dead volume.

Program for analysis was developed by Mr. P. Treciokas in 1978 for analysis of similar survey on small areas. The same program, with necessary modifications, will be used for the analysis of 1979 data.

Methods For Intensive Survey

Area selection

Survey areas will be selected in 2 stages. First, an aerial sketch mapping survey will be flown to locate areas where concentrations of balsam fir occur (25 percent or more of trees dead). Areas of at least 10,000 acres with scattered small pockets of mortality, or single areas of 5,000 acres with mortality will be mapped and surveyed.

Description of sample points

Each sample point will consist of 5 10-factor temporary prism points located as follows. Sample point center is prism point 1; and the other four will be taken in cardinal compass directions, clockwise, and 2 chains away from the center.

The sample point location will be marked on the photo or map, showing the compass direction and the distance from nearest roadway (or waterway). The survey crew will be expected to find that location.

Prism points and data collection

The center of the point will be marked with a staff. A 10-factor prism will be used to tally trees in the plot. A tree will be counted only when it has at least 1 pulpwood stick (8ft. and 4" min. top diameter). Borderline trees will be measured to decide on in or out.

Sample points will be identified by Township, Range and Section (MFS Fire Sections will be used). The over-all stand condition will be rated after all the prism points have been examined (MFS Ashley's code will be used). The tree data will be collected from 5 prism points at each sample point; however, all the data will be recorded on one data sheet and used as 1 sample.

At each prism point, a tally of merchantable trees will be taken by condition class:

1. Live; all indications are that the tree will be alive the following year; inner phloem at dbh is white, without signs of browning, or dying tissues.

    a. Healthy; at least some foliage present in upper half of the tree.

    b. Defoliated, or dying.

2. Dead; at least some browning spots or streaks already present in phloem at dbh. (Note in remarks if tree appears to have died from non-defoliation causes). Include only currently killed trees with fine twigs present in the tree crowns.

Sample plots

Each mortality area will be evaluated as a unit. Volume estimates will be made to give ±25 percent error of the mean estimate. About 20 or less plots will be needed. Location of sample plots will be chosen in a systematic fashion from a grid covering the mortality area. Each sample plot and prism point will be similar to that described in the extensive survey. Extensive survey data forms and similar analysis will be made for each mortality area.

Reports

Data analysis will begin about December 1, 1979 (delay is caused by unavailability of Mr. P. Treciokas, whose 180 day appointment cannot be renewed until middle of November). First draft of the report is expected by February 1, 1980, and final report is targeted for publication within 90 days (6-1-80).

Personnel Requirements

The project will be under general supervision of Dr. I. Millers, Portsmouth Field Office, USDA Forest Service. Mr. P. Treciokas will assist in the supervision of map preparation and field work. Data analysis will be done by P. Treciokas.

Field data will be collected by 5 crews of 2 persons hired from temporary summer employment lists. One person per crew will be assigned as the crew boss. It is estimated that the field work will require about 6-8 weeks (300-400 person days).

Cooperation

Maine Forest Service will provide technical assistance and data from aerial surveys available within their normal scope of work. USDA Forest Service crews will work within the authorities and limitation afforded to the Maine Forest Service, while in the State of Maine. Private industry will be contacted when work will be performed on land under their management, for maps, technical advice and trespass limitations.

ESTIMATED BUDGET AND FUNDING NEEDS FY 79

ITEM	FEDERAL FUNDS			NON - FEDERAL CONTRIBUTIONS		
	On Hand Oper. $	Additional Request				
		Field Office	Cooperator	State	Industry	
SALARIES						
Perm. Full Time	xxxxx	0	0	1,000	500	
Temp. Full Time	0	14,400	0	0	0	
Overtime	0	0	0	0	0	
PER DIEM						
Perm. Full Time	0	1,000	0	0	0	
Temp. Full Time	0	20,900	0	0	0	
TRANSPORTATION						
Vehicles	0	5,000	0	0	0	
Aircraft	0	2,500	0	1,000	1,000	
Commercial	0	0	0	0	0	
CONTRACTS						
MISCELLANEOUS						
Overhead						
Computer		1,000				
Supplies, equipment		1,000				
Report Publication						
TOTAL		45,800				

ESTIMATED BUDGET AND FUNDING NEEDS FY 80

ITEM	FEDERAL FUNDS			NON - FEDERAL CONTRIBUTIONS		
	On Hand Oper. $	Additional Request				
		Field Office	Cooperator	State		
SALARIES						
Perm. Full Time						
Temp. Full Time		1,600				
Overtime						
PER DIEM						
Perm. Full Time						
Temp. Full Time						
TRANSPORTATION						
Vehicles						
Aircraft						
Commercial						
CONTRACTS						
MISCELLANEOUS						
Overhead						
Computer						
Report Publication		1,000				
TOTAL		2,600				

SBW MORTALITY SURVEY--MAINE 1979

Cruiser _____ Date _____

FIELD TALLY FORM

T___ R___ NO.___

Defoliation Rating

_____

_____

_____

_____

_____

Remarks

BASAL AREA TALLY

	fir			spruce		
	live	dying	dead	live	dying	dead
1						
2						
3						
4						
5						
T						

VOLUME TALLY

(No. of 8 ft. sticks)

	fir														spruce														
	live							dead							live							dead							
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

T___ R___ NO.___

Defoliation Rating

_____

_____

_____

_____

_____

Remarks

BASAL AREA TALLY

	fir			spruce		
	live	dying	dead	live	dying	dead
1						
2						
3						
4						
5						
T						

VOLUME TALLY

(No. of 8 ft. sticks)

	fir														spruce														
	live							dead							live							dead							
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

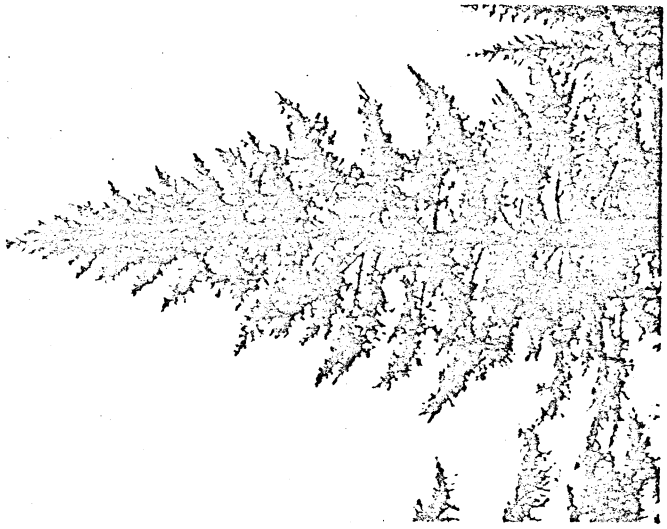


Fig. 11. Good — Only current defoliation, if any. No reduction in leader or twig growth. Tree has the potential to sustain its current rate of growth if further feeding does not occur.

Fig. 12. Fair — Moderate past feeding. Leader and twig growth somewhat reduced, but live buds are present. Mortality is possible if fed upon heavily for the next two years or more.

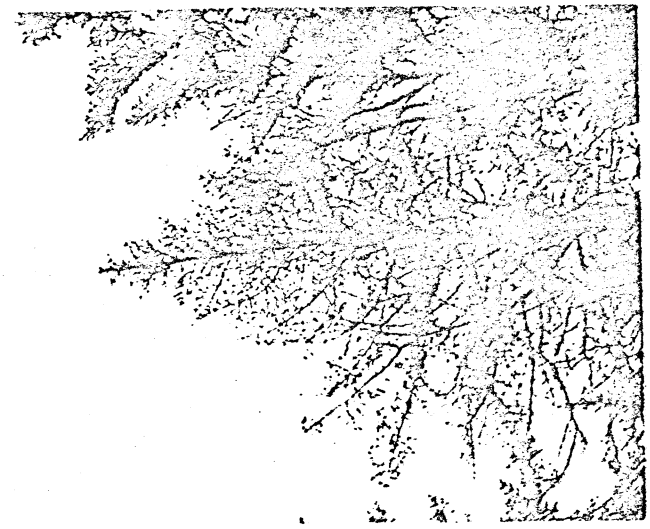


Fig. 13. Poor — Heavy past feeding. There is short twig and leader growth. The needle complement and live buds are severely reduced, small and weak. If heavy feeding continues next year, death will likely occur.

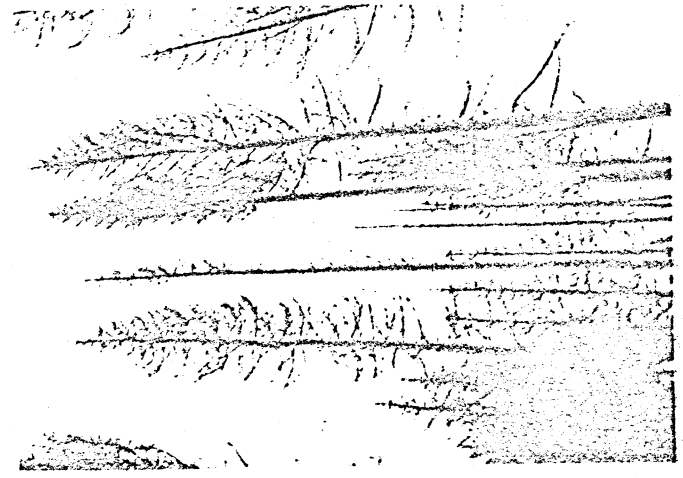


Fig. 14. Very poor (extreme) — Dead tops and few needles remaining. Crowns are thin and greyish in appearance. Short growth and buds are severely reduced, small, weak or completely lacking. The tree has no ability to recover and death is imminent even if feeding does not continue.